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Arrhythmia graphics

Wide-complex tachycardia: What is the diagnosis?

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A 25-year-old male presented with multiple episodes of palpitation with no haemodynamic instability. The frequency of palpitation was less while he was on beta blockers or calcium channel blockers. Physical examination revealed no evidence of cardiovascular disease, and echocardiogram and baseline electrogram were normal. All the recorded tachycardia electrograms showed wide QRS complex tachycardia with left bundle branch block (LBBB) morphology (Fig. 1). The intracardiac tracings are given in Fig. 2. What is the diagnosis?

1. Discussion

An LBBB-like tachycardia could be due to any of the following: supraventricular tachycardia (SVT) with LBBB (pre-existing or rate-related) aberrant conduction, pre-excited tachycardia mediated through a right-sided accessory pathway (AP), and ventricular tachycardia (VT) arising from right ventricle (RV). The precordial QRS transition is at V4/V5 in this case. SVT with aberrancy is expected to have precordial QRS transition earlier than V5 in a structurally normal heart. The late precordial transition beyond V4 favours either VT or a pre-excited tachycardia through an atriofascicular pathway ('Mahaim fibres') with its distal insertion close to or at distal right bundle. The second notable feature in this tracing – an early intrinsic deflection – does not favour a myocardial VT or pre-excited tachycardia through short trans-annular atrioventricular (AV) connections ('Kent bundles'). In contrast, this feature represents ventricular activation through the Purkinje system as in SVT with aberrancy or pre-excited tachycardia through atriofascicular connection. In addition, absence of pre-excitation at basal ECG makes pre-excited tachycardia through Kent bundle unlikely. An rS pattern in lead III is an additional feature which represents, in a pre-excited ECG, an activation vector towards base in a small area of anterolateral RV, as commonly seen in cases with atriofascicular pathway. This finding is not seen with pre-excitation through short AV connections with ventricular insertion close to the tricuspid annulus. So, early intrinsicoid deflection, late precordial transition beyond V4, and rS pattern in lead III during tachycardia suggest a pre-excited tachycardia through Mahaim fibre in this case. Furthermore, pre-excited tachycardia mediated by Mahaim fibre can be any of the following: antidromic tachycardia with AV node as the retrograde limb as the commonest one, pathway to pathway conduction with another AP as the retrograde limb, or bystander AP conduction from an AV nodal re-entrant tachycardia or atrial tachycardia/flutter as rarer possibilities. Differentiation of these diagnoses, needs analysis of intracardiac tracings as well.

The Fig. 2 shows the intracardiac electrogram during the tachycardia. The LBBB-like pre-excited QRS morphology, negative HV interval (ventricular activation preceding the activation of His bundle), and concentric 1:1 ventriculoatrial conduction suggest antidromic tachycardia through a right-sided AP. The observation that the ventricular electrogram at RV apex is earlier than that at AV annulus (represented by His bundle in this tracing) suggests atriofascicular pathway as the antegrade limb. The relatively short ventricular-His interval and the absence of more pronounced slurring at the QRS onset during antidromic tachycardia are two additional features to suggest the distal insertion of AP to the bundle or Purkinje system than directly to myocardium.

Despite the controversies in nomenclature, atriofascicular pathways are generally referred to as Mahaim fibres, and are characterised by slowly and decrementally conducting (AV-node like) tracts, which allow conduction unidirectionally only – from atria to fascicles. Unlike AV node, which is a septal structure, atrial insertion site of these tracts is in the right atrial free wall close to the tricuspid valve. These bypass tracts tend to cross the lateral tricuspid annulus (in almost all cases), run along RV free wall to the region where the moderator band usually inserts at the apical third of RV free

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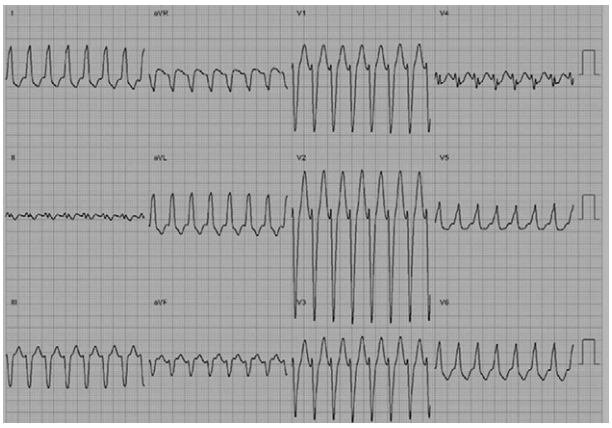

Fig. 1 – Twelve-lead ECG during tachycardia. A wide-complex tachycardia of LBBB morphology at 180 bpm, with QRS axis of −15°. P waves are not seen. Note the rapid intrinsic deflection, clearly evident in right precordial leads.

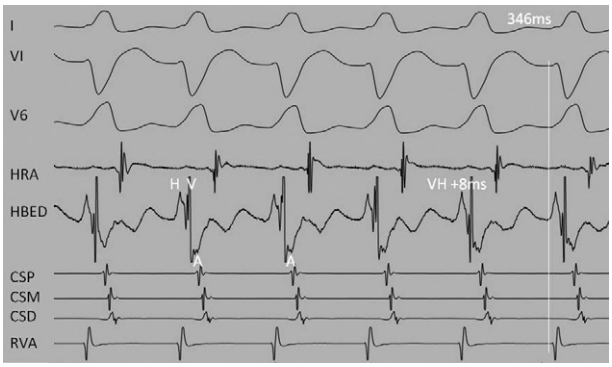

Fig. 2 – Surface ECG (leads I, V1, and V6) and intracardiac recordings during tachycardia. The HV interval is −8 ms and the earliest ventricular activation is at RV apex. The earliest atrial activation is at distal His-bundle electrogram (HBED); HRA: High right atrium; CS (P, M & D): Coronary sinus proximal, mid and distal; RVA: right ventricular apex.

wall, inserting into the distal part of the right bundle or ventricular myocardium close to the right bundle. The proximal atrial insertion of these pathways can be localized with the recording of AP potential, which can be targeted for ablation.

Apart from these anatomical characteristics, certain electrophysiologic properties make these pathways unique among aberrant AV connections. During sinus rhythm, ECG shows normal QRS or minimal pre-excitation in most patients as the conduction time through these pathways exceeds that through the normal AV conduction system. Subtle pre-excitation through these right-sided pathways is suggested by the absence of normal septal forces (small q waves) in leads I, aVL, and V5–V6, and the presence of an rS complex in lead III in the setting of a narrow QRS. Even in cases with well pre-excited cases i.e., those with typical LBBB, presence of a normal PR interval may occur secondary to the slow conduction through the pathway. Precordial transition usually occurs at V4–V6 in fully pre-excited ECG. Because of the absence of retrograde conduction in these pathways, they cannot mediate orthodromic reciprocating tachycardia. Antidromic tachycardia with anterograde conduction over Mahaim fibre is the most common type of tachycardia associated with Mahaim fibres. During this reentry, conduction travels antegradely down AP, to the right bundle branch (typically), and retrogradely back up to the His bundle, AV node, and then atrium. This fully pre-excited tachycardia is characterised by LBBB-like configuration with a smooth slope of the downstroke in V1, and a frontal plane axis generally between +30° and −75°. The closer the distal end of the fibre to the right bundle branch, the narrower the QRS. In conclusion, wide-complex tachycardia with LBBB morphology in young with no structural heart disease and subtle or no pre-excitation at baseline ECG should make one suspect the possibility of atriofascicular pathway mediated tachycardia.